

V. *On the Structure of the Lampyridæ, with reference to their Phosphorescence.* By the REV. H. S. GORHAM.

[Read March 3rd, 1880.]

THE interest taken by the members of the Society who were present when I rather briefly stated some morphological observations I had made while studying the *Lampyridæ*, was so much greater than I had anticipated, that I think it worth while to lay before the Society a fuller summary of those facts, and venture to restate in a rather fuller form, and, if I can, more clearly, the conclusions at which I arrived.

I think it will be admitted that generalisations founded on a limited number of phenomena are only misleading, and have no sure basis, while in those founded on a large number of facts, some cases are sure to be found, which may at first seem adverse to the conclusion which we are at last compelled to adopt.

This has been the case here. There are examples, such as the non-luminous species, which I do not profess to say more about than that they do not invalidate the general conclusion at which I arrive, which is that the sexual instinct has played a large part in moulding the external structure of this group of beetles, and that it is to that we may look for an adequate explanation of the wonderful development of phosphorescent light, though perhaps not to its origin.

In the first place, then, it is to be observed that all the species of this family do not possess the luminous faculty in equal degree; but that on the contrary, while some are highly luminous in both sexes, some are only highly so in the female, some are not luminous in either sex, and some (though this appears rather doubtful) are luminous in the males, and not so, or much less so, in the female.

The part which this faculty of emitting light plays in the economy of nature has been long and earnestly debated. The most general view, and therefore one to which I lay no claim for originality, but which my observations tend to confirm, is that it serves as a beacon to attract the male to

the female ; but I believe this to be the case only in a special sense in those species which do not assemble, and especially in those in which the females are incapable of flight. In other cases I believe that *both* sexes are attracted, and enabled by this means to assemble at night for their union. These inferences are drawn from the consideration of the relative development of the eyes, together with what is known of the habits of the various species.

The eyes of the *Lampyridæ* are, I find, developed in magnitude according to the amount of luminosity of the species considered. And the other parts which I have taken account of, together with these, are the antennæ, of which there is a very great diversity, both between the sexes, and in the genera ;—the elytra, which are also subject to sexual and generic limitations, and finally the size of the abdomen in the female.

The last mentioned is no doubt, as in other apterous females, the result of an increased production of *ova*. These are, I believe, in the *Lampyridæ* laid on roots, and other substances near the ground, where the young larvæ will at once be likely to meet with their molluscan diet. The greater the tendency to produce *ova* in abundance, the more sluggish the females would become, and hence females once capable of flight would lose the use of their wings, and the *usefulness* of the light to attract their more volatile partners would be greater than ever. This I believe to be the explanation of the fact that the highest degree of light, or at any rate the greatest disproportion in the amount shown by the sexes, is to be found in those species which have apterous females, and together with this the greatest development of eye in the male. We will now consider the case of those species in which both sexes are winged, and in which both are luminous, and in probably nearly equal degree. Such are, I have reason to think, by far the large proportion of the whole number of existing species. In this case the power of emitting light would be obviously useful in attracting both sexes to assemble in swarms, and it does not militate against this supposition that in many species the males should possess this faculty in the higher degree. It might be anticipated that if the female has to be guided to the rendezvous of the species by this effect, the eyes in that sex would not be inferior to those of the male ; and such is the fact. To save repetition here I will only instance one well-known case, viz., that of the European and Eastern genus

*Luciola*. Here both sexes fly, both are luminous, and both have largely developed powerful eyes.

Neither of these sections, however, comprise those species which are generally regarded as most typical of the family, the largest, and those which appear on the whole to have all their parts most highly specialised, and which, therefore, we place at the head of a systematic list, such as the genera *Lamprocera* and *Cladodes*. It is rather remarkable that in these genera the light-emitting faculty has not been developed in the same proportion as the rest of the organs have, and that while one of these, viz., the eyes, are also reduced in a direct ratio with the light, and are small and uniform in both sexes, another organ, the antennæ, is developed in inverse ratio as the phosphorescence is diminished. I do not here speak of mere length, or redundancy in the number of joints, which are more usual in very simple and primitive forms of the organ, such as we see in *Blatta*, but of a high degree of specialisation, testified by large lamellar plates, or pectination. Whether the eye is developed at the expense of the antenna, and is so to speak the receptacle of all the vital forces of the head, or whether the antenna supplements the loss of the other organ of sense, and is useful in detecting the presence of the female, I only see one fact in evidence, which is that this plumosity of the antennæ, in one case, and this enormous development of the eye in the other, are usually sexual characters predominating in the male, but sometimes found in both sexes.

I now offer some evidence in support of my view. The species I have selected to illustrate the subject I have arranged in three groups.

i. Species with plumose antennæ, small or moderate eyes, both sexes winged, light-emitting surface confined to one or more small spots. Genera exhibited *Lamprocera*,—*L. Latreillei* ♂ ♀. The male only is luminous, and apparently only slightly so. *Cladodes*,—*C. lamellicornis*. *C. plumosa*, Gorrh. The sexes are as yet undistinguishable. *Vesta*,—*V. saturnalis*, Gorrh. *Lucidota*,—*L. flabellicornis*, *Phænolis*,—*P. plumosa*, Gorrh. *Megalophthalmus*, *M. Guatemalae*, Gorrh. Of this genus it is noticeable that Lacordaire remarks the name is unfortunate, as the eyes are *not* larger than is usual in this family.

ii. Species in which both sexes are winged; light

emitted considerable, sometimes greater in the ♀. Eyes large, sometimes excessive. Antennæ simple, usually filiform. Genera,—*Cratomorphus*,—*C. giganteus*, *C. fuscipennis*. *Lucernula*,—*L. fenestrata*, *Aspidosoma*,—*A. laterale* ♂. *A. egrotum*, Gorh. ♂ ♀. *Luciola*,—*L. italica*; *L. lusitanica*; *L. vespertina*. *Photuris*,—*P. pennsylvanica*.

iii. Species in which the female is apterous or with rudimentary wings; light emitted often very great in the female, and often only rudimentary traces of it in the male. Antennæ usually rudimentary. Eyes large in the male, often excessively so, occupying nearly the whole head. Genera,—*Pleotomus*,—*P. pallescens*, ♂ ♀; *Lamprophorus nepalensis* ♂; *Microphotus*, M. n. sp. *Lampyrus*,—*L. noctiluca* ♂ ♀; *L. mauritanica* ♂ ♀; *L.* sp.? Africa; *Lamprorhiza*,—*L. Delarouzei* ♂ ♀.

iv. Three abnormal genera which do not seem to form cases in point. *Alychnus*,—*A. xanthorrhaphus* ♂ ♀. This being quite non-luminous appears only to offer negative evidence. The eyes are not developed. *Dioptoma*,—*D. Adamsi*,—the eyes are enormous, but I do not know anything about the luminosity. *Amythetes*,—*A. fastigiata*. The antennæ are plumose, and both sexes I believe luminous, but the insect is quite abnormal; the antennæ are redundant in the number of joints and the plumosity very soft and fine. I should consider them simple rather than specialised.

With regard to the power of withdrawing the light proved I believe to exist in these insects, whether suddenly and intermittently as in the instance of the *Luciola*, or gradually as I have observed in *L. noctiluca*, the explanation is I think that the external white vitreous-looking parts are only diaphanous, not themselves the source of the light which is within the body of the insect and can be pressed against these windows, or retired from them at its pleasure.

I think Newport observed that these segments in the female of *L. noctiluca* were detached from the internal parts on dissecting them. The circumstance of the *Luciolas* thus flashing in unison would on this hypothesis easily be accounted for, by any exciting cause, such as the arrival in the swarm of a fresh female, or the gusts of air, which affected them all at one time. And the comparative hardness of the body in this genus seems to favour the idea that this may be really the case.

I trust I shall not have been too prolix or to have dwelt longer on the subject than it deserved. I have for some years taken the greatest interest in the distinctions in the sexes of insects, and the apparent cause of these diversities, or ends gained by their means, and you will see that the theory of their gradual development forms part of my suggestion.

We do not find here the feet with widened tarsi, or patellated front feet with roughened elytra in the female, as in the Carabidæ and Water-beetles, nor prehensile bent tibiae in the male as in Necrophaga, Weevils, and many other groups, nor teeth developed on the tibiae, nor claspers to the abdomen, nor the enormous jaws of *Lucanus* by which, as I have observed, he can throw a rival as an athlete does his antagonist, nor fighting horns as in many Coleoptera. But what we do find is a simple natural variation, taken advantage of with such success, that it has proved sufficient to mould at least two other organs by its application to the insect's necessities: one the eye in the direction of developing its power, the other the antenna by correlation in the opposite direction of reducing it to a rudiment. The light of *Lampyridæ*, which *may* have originated with their molluscan diet, has been sufficient to develop the most perfect eyes I have noticed in Coleoptera: while it has rendered unnecessary and checked the original tendency to plumosity in the organ of touch, wherever it has been taken advantage of in any considerable degree.

Among the numberless variations that arise naturally in the animal and vegetable kingdom, man is ever availing himself of those he desires, and is, to a great extent, able to render those that are useful permanent, and to check those that are not so, and it appears to me that I have shown you an example where nature has proceeded in the same way.

Our Vice-President, in his address, exhorted us in our papers to bring our attention to bear on the morphological characters and habits of the creatures we study. If I have relieved the monotony of the technical descriptions, and mere classification of these beetles, which the Society has received so favourably, and taken a step in the direction he indicated, I shall feel I have not wasted your time, and shall be recompensed if the discussion of the subject brings out any new facts for its elucidation.

